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New
Sahonagasy Action Plan
2016-2020



New Sahonagasy Action Plan 2016 – 2020

Nouveau plan d'Action Sahonagasy 2016 – 2020

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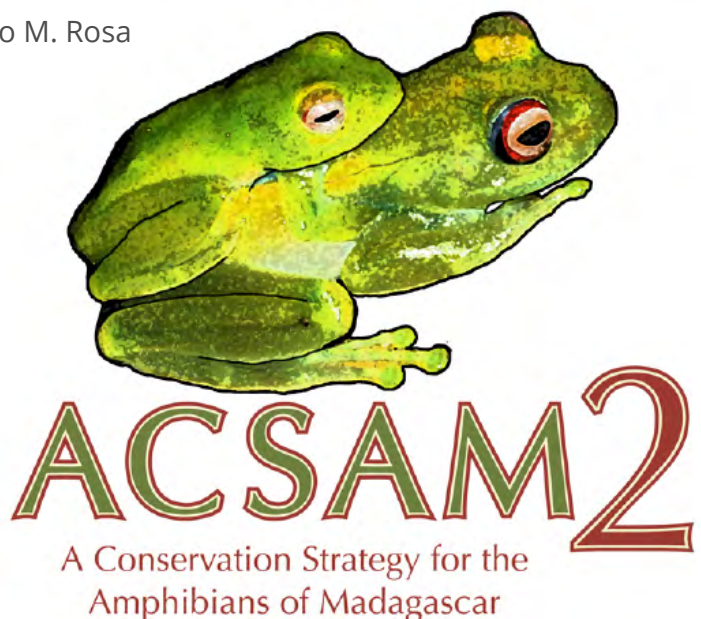
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Founded in 1948, The International Union for Conservation of Nature brings together States, government agencies and a diverse range of nongovernmental organizations in a unique world partnership: over 1,000 members in all spread across some 140 countries. As a Union, IUCN seeks to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. The IUCN builds on the strengths of its members, networks and partners to enhance their capacity and to support global alliances to safeguard natural resources at local, regional and global levels.

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The Species Survival Commission (SSC) is the largest of IUCN's six volunteer commissions with a global membership of 8,000 experts. SSC advises IUCN and its members on the wide range of technical and scientific aspects of species conservation and is dedicated to securing a future for biodiversity. SSC has significant input into the international agreements dealing with biodiversity conservation.

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The IUCN SSC Amphibian Specialist Group (ASG) is a global volunteer network of dedicated experts who donate their time and expertise to create a community from where practical amphibian conservation can be advanced based on a solid foundation of science. This network consists of over 500 members in over 40 Regions/Countries, enabling the ASG to act on a global scale.

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Durrell Wildlife Conservation Trust is an international charity working globally to save species from extinction. Headquartered in Jersey in the Channel Islands, Durrell focuses on the most threatened species in the most threatened places. Established by author and conservationist, Gerald Durrell, in 1963, Durrell is unique among conservation organisations in integrating four core areas of operation: the Wildlife Park in Jersey as a centre of excellence in animal husbandry, research, training and education; the Field Programme which undertakes conservation action where it is needed most; the Conservation Academy which builds the capacity of conservation practitioners; Conservation Science which underpins all activities.

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The Amphibian Survival Alliance (ASA) is the world's largest partnership for amphibian conservation, formed in response to the decline of frogs, salamanders and caecilians worldwide. Without immediate and coordinated action we stand to lose half of some 7,000 species of amphibians in our lifetimes. The ASA draws on cutting-edge research to protect amphibians and key habitats worldwide, in addition to educating and inspiring the global community to become a part of the amphibian conservation movement.

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FOREWORD



AVANT PROPOS

La particularité de Madagascar réside en son richesse en termes de biodiversité. Des espèces rarissimes ne se retrouvent qu'ici. Pour les amphibiens, plus de 250 espèces sont décrites et 99% sont endémiques. Ils constituent un groupe très diversifié, allant du petit Mantella de couleur vive à la grenouille tomate du Nord-Est. D'autres espèces de myriades sont moins bien connues.

Malheureusement, toutes les espèces de faune endémiques sont menacées d'extinction. La pratique de la culture sur brûlis, l'exploitation forestière et l'assèchement des zones humides ont entraîné des pertes de milliers d'hectares de leur habitat naturel.

Les grenouilles sont très sensibles aux changements environnementaux et leur disparition met en évidence une grave dégradation de notre environnement. Ils donnent une indication sur la propreté de l'eau et la richesse du sol. Il est donc important de veiller à ce que ces processus naturels soient préservés.

Un nouveau plan d'action Sahonagasy décrit une série d'actions et d'objectifs pour protéger les amphibiens de Madagascar.

La mise en œuvre de ce plan au cours des cinq prochaines années permettra la conservation des amphibiens. J'encourage tous ceux qui sont impliqués pour la réussite de cette gageure.

LE MINISTRE DE L'ENVIRONNEMENT,
DE L'ÉCOLOGIE ET DES FORÊTS



Johanita NDAHIMANANJARA

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INTRODUCTION





Dyscophus antongilii © Franco Andreone

When, at the end of the 1980's, I traveled to Madagascar driven by my passion in herpetology, comparatively little was known about the conservation issues of the country's endemic amphibians. During my first expeditions, I had with me a copy of the grey-covered "Faune de Madagascar", authored by Blommers-Schlösser and Blanc. Unfortunately, species identification was a gamble and many descriptions were based upon museum specimens. This situation suddenly changed when Glaw and Vences published the first of three editions of their renowned fieldguides, thus posing the basis for the description of an impressive number of species and highlighted the high value of Madagascar as an amphibian diversity hotspot.

Currently, as of late 2015, Malagasy frog species number around 300, but another 200 still wait to be formally described. This rapid taxonomic turnover has been almost inextricably linked with the knowledge and understanding that the frogs' original natural habitats—mainly rain and dry forests—were rapidly disappearing and

that new threats were emerging. I soon realised that many species were subject to the herpetological pet trade, that was often indiscriminate and without control. As a consequence of this trade one of the most iconic Malagasy species, the tomato frog (*Dyscophus antongilii*), had already been included in Appendix I of the Washington Convention (CITES). At the same time, many species of *Mantella*, which are characterized by contrasting colors and largely diurnal activity, were exported but not yet regulated (except for *Mantella aurantiaca*). Trade in species along with the high rate of deforestation in Madagascar has always acted as an ecological alarm bell for conservation emergencies, including the country's frogs. As such several herpetologists working in Madagascar started addressing the public's attention to the particular ecological sensitivity of and threats facing frogs. Put simply, as interest regarding some of the most iconic animals of Madagascar, the lemurs, grew it did also for amphibians, giving rise to a high conservation interest in amphibians within a few years.

In response to a mandate made by famous conservationists working in Madagascar, such as Russ Mittermeier and Olivier Langrand at the development of the Amphibian Conservation Action Plan (ACAP) in Washington D.C. in 2005, I did my best to put together a project and gather people to create a global initiative of conservation for Malagasy amphibians. The first step in this was the establishment of the IUCN SSC Amphibian Specialist Group for Madagascar, co-chaired by myself and first Herilala Randriamahazo and later Nirhy H.C. Rabibisoa. The ASG Madagascar oriented and directed much research conducted on amphibians in Madagascar with a particular attention to their conservation and in 2006 organised the first ACSAM (A Conservation Strategy for the Amphibians of Madagascar) workshop in Antananarivo. This international conference was attended by many people, including researchers, conservationists and politicians from Madagascar and internationally. It enabled people to discuss and put together the first national action plan for amphibians, called the Sahonagasy Action Plan (“sahona” in Malagasy means “frog,” while “gasy” is a contraction for “Malagasy”). The SAP was subsequently officially accepted by the Malagasy authorities, making Madagascar one of the first nations to define a strategy specifically for the conservation of amphibians.

The years following the SAP saw the number of studies being conducted on amphibians increase, along with more specific attention on some iconic species. Symbols of this conservation have included the harlequin mantella (*Mantella cowanii*) in Antoetra, the golden mantella (*Mantella aurantiaca*) in Torotorofotsy and Mangabe areas, and the micro-endemic frogs (*Mantidactylus pauliani* and *Boophis williamsi*) from the Ankaratra Massif. Put simply, the SAP and ACSAM has allowed people to put “conservation into practice”. An important outcome was also the constitution of the Chytrid Emergency Cell (CEC), a group of national and international researchers, who started to raise attention in Madagascar to one of the worst pathogens affecting amphibians globally, the chytrid fungus (*Batrachochytrium dendrobatidis*) which was

recently discovered in Madagascar. Chytrid, together with the invasion of the alien Asian toad (*Duttaphrynus melanostictus*) around the Toamasina (Tamatave) area, have become two of the highest conservation priorities in recent years in addition to the continued habitat loss. These new threats also laid the basis for the realisation in 2014 of a second meeting and workshop, named ACSAM2 to develop an updated SAP. This took place in the attractive landscape of the Parc National de Ranomafana and again brought together researchers, conservationists and politicians from Madagascar 8 years after the first ACSAM. It provided an opportunity to review the progress made against the actions from the 2008 Sahonagasy Action Plan (see Appendix for this review) and develop a new set of strategies and revised actions.

It is now time to develop and implement the new strategies and define relevant actions that are duly highlighted in this Sahonagasy Action Plan “Vaovao” (new). We all believe that in the forthcoming years successful conservation actions will increase, making of Madagascar a pioneer country in putting amphibian conservation into practice.

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CHYTRID IN MADAGASCAR: AN OVERVIEW OF THE PAST, PRESENT AND FUTURE INITIATIVES

The emergence of infectious diseases is playing a crucial role in the global amphibian decline and a considerable portion of the efforts of the 2008 Sahonagasy Action Plan (SAP) have been invested in this direction.



Chytrid monitoring at Ankaratra. © Durrell Wildlife Conservation Trust

By the time SAP saw daylight, the pathogenic fungus known as *Batrachochytrium dendrobatidis* (*Bd* or chytrid) was thought to be absent from Madagascar. This made Madagascar a perfect system where pre-emptive measures against chytrid could be put in place. Activities to address the potential threat of *Bd* began proactively in October 2010, with a workshop on chytrid prevention held at Parc Ivoloïna. As a result of this workshop, an “emergency unit” (Chytrid Emergency Cell, CEC) the government-appointed body to lead and coordinate the monitoring and response actions related to *Bd* in Madagascar was created, and numerous training opportunities have been developed for students, researchers and decision makers in Madagascar. Simultaneously, a National Monitoring Program for the early detection of *Bd* was initiated. This effort was soon coupled with the establishment of a research program aiming to identify effective probiotics for Malagasy frogs, and to successfully and safely implement probiotic therapy through bioaugmentation. Supported by ASG, the CEC has also been working with the Malagasy government to

implement quarantine measures related to commercial trade in aquarium fishes and plants to prevent the accidental introduction of *Bd*.

After the first detection of *Bd* in 2010 in Madagascar, new priorities have been identified in the New Sahonagasy Action Plan to deal with this potential conservation crisis. These include the implementation and dissemination of biosafety protocols among researchers and authorities, the development of an emergency response strategy, the establishment of a national protocol to streamline permitting issues, and finally enhance both mitigation research and *ex situ* conservation capacity. Also in terms of research it was found crucial the maintenance of a monitoring program, the identification of the *Bd* lineage(s) and the characterization of its/their virulence.

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DEVELOPING MADAGASCAR'S EX SITU CONSERVATION CAPACITY

The ability to establish captive survival assurance colonies of threatened Malagasy frog species was a major objective of the 2008 Sahonagasy Action Plan (SAP). Since its publication, a number of important steps have been made, notably with the launch of Madagascar's first captive breeding facilities.



Training at Parc Ivoloïna. © Devin Edmonds

Located in Andasibe and managed by the community-run Association Mitsinjo in collaboration with the Direction Générale des Forêt and Amphibian Specialist Group of Madagascar, the first facility of this kind was launched in April 2011. Aligning with the objectives of the SAP, the facility's local staff conduct husbandry research to determine the captive requirements of species from varied ecological guilds. The project also maintains a genetically viable population of *Mantella aurantiaca* from a population now extirpated due to mining activities.

To date Mitsinjo's facility has maintained eight frog species, breeding three to the F2 generation and conducting a number of valuable studies that have led to better management practices for species previously unknown in captivity. Perhaps even more importantly, a team of half a dozen Malagasy technicians are now experienced in maintaining captive amphibians and their live food cultures.

Captive breeding progress has also been made further east at Parc Ivoloïna. Following a Chester Zoo and Durrell Wildlife Conservation Trust led workshop in 2012, Parc Ivoloïna began developing a facility dedicated to amphibian conservation and captive breeding. Although still in its early stages, three Parc Ivoloïna keepers have since begun successfully culturing live foods, which is the first step to running amphibian breeding programmes. The development of Mitsinjo's and Parc Ivoloïna's breeding facilities highlights the progress made towards increasing ex situ conservation capacity within Madagascar since enacting the original SAP, and which we expect to grow further through this updated SAP.

Devin Edmonds, Association Mitsinjo, Andasibe, Madagascar

ENGAGING STAKEHOLDERS IN AMPHIBIAN CONSERVATION

Establishing new protected areas for amphibians was one of the key actions of the 2008 Sahonagasy Action Plan (SAP). Since then, two Malagasy conservation organizations have been working to create two new protected areas for amphibians: Association Vondrona Ivon'ny Fampandrosoana who created Ankaratra in the central highlands, and Madagasikara Voakjy (MaVoa,) who created Mangabe-Ranomena-Sahasarotra (Mangabe) in eastern Madagascar.



Mantella aurantiaca © Franco Andreone

Mangabe was created mainly for the conservation of the Critically Endangered golden mantella frog *Mantella aurantiaca*. Located south of Moramanga town, Mangabe holds over 60% of the known breeding ponds for this species. A specific conservation strategy was developed for the species in 2010 and highlighted the need to create Mangabe as a protected area.

Creating Mangabe new protected area required an engagement of all stakeholders, from the local communities to the national decision-makers. As such, MaVoa, organized over 60 meetings at the villages, Fokontany, Communes, District, Region and national levels. These meetings aimed to increase awareness of all stakeholders on the existence of this unique species, obtain their views on its conservation and the site overall, and define the plan for the protected area management. In addition awareness campaigns were also conducted in villages;

at the primary schools in the area; in the town of Moramanga and at national events. As a result, Mangabe management plan was approved by the Malagasy government and a decree for its definitive protection was promulgated in April 2015 (decree n° 2015/725).

Preventing further degradation of golden mantella breeding ponds remains a challenge in Mangabe new protected area. Local people and recent immigrants are not averse to converting them into rice fields and others, who are expecting to find gold there, have started digging holes. For the next five years, in accordance with the new SAP, we will be working to mitigating these threats.

Eddie Rakotondraso and Julie Hanta Razafimanahaka, Madagasikara Voakajy



NEW SAHONAGASY ACTION PLAN 2016 - 2020

This action plan is the result of discussions from the ACSAM2 'A Conservation Strategy for the Amphibians of Madagascar' meeting that took place at Centre ValBio, Ranomafana from the 18-22 November 2014 and three subsequent reviews.

A five-year action plan the actions for delivery are split into six broad themes as follows:

Theme 1: Coordination of research and conservation activities

This theme covers actions relating to overall delivery of the action plan including coordination, communication and fundraising. This theme also includes many cross-cutting actions such as education and awareness relating to amphibians; collection and export permits; in-country molecular laboratory development and in-country amphibian collections.

Theme 2: Monitoring Madagascar's amphibians and their environment

This theme covers actions to improve the understanding and knowledge around amphibians in Madagascar, their environment and threats. This includes identifying and monitoring key species and sites; developing the monitoring capacity within Madagascar and climate change research.

Theme 3: Emerging infectious diseases

This theme covers actions relating to chytridiomycosis and other infectious amphibian disease threats in Madagascar. This includes monitoring and research into disease threats; strategic planning for mitigating potential future disease outbreaks and disease specific education, awareness raising and communication.

Theme 4: Site management for the conservation of amphibians

This theme covers actions relating to improving the Protected Area coverage for amphibians in Madagascar. This includes developing new Protected Areas for amphibians and integrating amphibians more into existing Protected Area management plans.

Theme 5: Harvesting and trade of amphibians

This theme covers actions relating to the research and monitoring of amphibian species within both the international and domestic trade.

Theme 6: Captive breeding and zoo actions

This theme covers actions relating to the captive breeding of Malagasy amphibians' in-country and overseas. This includes the appointment of a dedicated *ex situ* Coordinator and captive breeding focussed action plan; capacity development in Madagascar and associated captive breeding awareness raising and research.

Acronyms

AArk	Amphibian Ark	MaVoa	Madagasikara Voakajy
ASA	Amphibian Survival Alliance	MEEMF	Ministère de l'Environnement, de l'Ecologie, de la Mer et des Forêts
ASG-Mad	Amphibian Specialist Group-Madagascar	MFG	Madagascar Fauna and Flora Group
ATAG/ EAZA	Amphibian Taxon Advisory Group / European Aquarium and Zoo Association	Mitsinjo	Association Mitsinjo
CEC	Chytrid Emergency Cell / Cellule d'Urgence	MNP	Madagascar National Parks
Chester	North of England Zoological Society, Chester Zoo	NGO	Non Governmental Organisation
CIBIO	Centro de Investagação em Biodiversidade e Recursos Genéticos, Portugal	NWU	North-West University, South Africa
CVB	Centre ValBio	PBZT	Parc Botanique et Zoologique de Tsimbazaza
DGF	Direction Générale des Forêts	SCAM	Société pour le Conservation des Amphibiens de Madagascar
Durrell	Durrell Wildlife Conservation Trust	TU	German Institutes of Technology
Imperial	Imperial College London	UADBA	University of Antananarivo, Department of Biology
JMU	James Madison University	ZSL	Zoological Society of London

Key to tables

Actions: Description of the actions to be implemented over the next 5-years under the guidelines that resulted from the ACSAM2 workshop

Priority: The relative priority in terms of amphibian conservation need. High, Medium, Low

Timeframe: The estimated time to implement the action within the scope of this Action Plan (2016 - 2020). Short (1-2 years), Medium (3-5 Years), Long (over 5 years or ongoing)

Indicators: How progress and success of the action will be measured. Ideally require a measure e.g. report and a target completion time e.g. Year 3

Institutions: The organisations, groups and individuals who have been identified to take the lead on implementing the action. Note these are NOT the only organisations who will be involved in implementing the action.

Notes and comments: Notes relating to the action e.g. possible risks or opportunities to achieving the action or suggestions made during ACSAM2 and subsequent consultation.

Theme 1: Coordination of research and conservation activities

Action	Priority (H, M, L)	Timeframe (S, M, L)	Indicators (By end of time frame or 5 years)	Institutions	Notes and Comments
1.1 Undertake a review of the ASG-Madagascar roles and form an Amphibian Committee Madagascar (ACM) to improve coordination and communication of Action Plan	High	Short	<p>ASG-Madagascar Executive Secretariat roles reviewed with revised terms and conditions by end Year 1</p> <p>Persons responsible for amphibians within other key institutions identified by end Year 1</p> <p>Roles of all members of Amphibian Committee Madagascar clarified by end Year 1 (document)</p> <p>Annual meeting of ACM to review progress of Action Plan (report)</p>	ASA / ASG, ACM	How best to implement - coordination and organisation are key; dedicated position with fundraising assistance from ASA is desirable.
1.2 Seek and secure funds to enable the continued coordination and implementation of the ACSAM2 Action Plan	High	Long	<p>Expert fundraiser engaged through ASA by end of Year 1</p> <p>Fundraising working groups established by end of Year 1</p> <p>At least 3 proposals submitted per year including 1 for regular testing of biological samples</p> <p>At least 1 project funding application per year includes a Climate Change component</p> <p>Coordination costs of Action Plan fully funded by Year 5</p>	ASA, ASG-Mad, multiple groups	<p>Engaging with expert fundraiser through ASA</p> <p>Climate Change can open up additional funding opportunities</p>

<p>1.3 Implement a set of initiatives to raise awareness of the value of amphibians across Madagascar</p>	<p>High</p>	<p>Long</p>	<p>Suite of awareness raising methods identified by end Year 1 (Report)</p> <p>Regions prioritised for awareness need identified by end Year 1 (Report/map)</p> <p>Awareness raising initiatives undertaken in at least one additional region each year from Year 2 - 5 (Reports)</p> <p>Awareness and education activities for schools e.g. mobile workshop running by Year 3</p> <p>Online amphibian field guide updated by end Year 3</p> <p>Key English language resources for translation identified by end Year 1</p> <p>Key English language resources translated into French and Malagasy and disseminated by Year 5</p> <p>Sahonagasy website updated by end Year 2</p> <p>Regular management of website undertaken at least twice per year</p> <p>Database created on web interface and updated by end Year 2</p> <p>Information in database fully updated annually (Report)</p> <p>Education exhibit options at national zoos and Protected Areas assessed and locations identified in Year 2</p> <p>At least one new exhibit in place by Year 5</p>	<p>ASG-Mad, MNP, various NGO's, Ministries</p>	<p>Regional Posters; info booklets; alternative ways of communicating; radio and media; Malagasy Frog Festival day.</p> <p>Alliance Vohary Gasy; Peace Corps; REPC; are potential groups to engage with</p> <p>Amphibiaweb has species accounts and an option for uploading documents.</p> <p>Utilise web groups such as LinkedIn for open-access to papers.</p> <p>EAZA institutions may help with translation.</p> <p>Linked to Action 6.9</p>
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1.4 Hold annual meeting with Government and authorities on amphibian conservation in Madagascar and progress of ACSAM2 Action Plan	High	Long	List of ministries, agencies and bodies identified during Year 1 At least 1 meeting held with each group each year (recorded minutes)	ACM, MEEMF, identified Government agencies and bodies, NGOs	Not just the Ministry of Environment. List made for the 2008 Sahonagasy Action Plan can be used as base.
1.5 Undertake an evaluation of threatened species conservation projects and action plans	Medium	Medium	Threatened species conservation projects and action plans evaluation report by end Year 3	ASG-Mad	Species Action Plans exist for <i>Mantella aurentiaca</i> and <i>M. cowani</i> .
1.6 Biennially (every 2 years) assess the impact and opportunities of national legislation upon amphibian conservation	Medium	Long	Report produced every 2 years and submitted to appropriate authorities	ASG-Mad	Need to influence any legislation prospectively
1.7 Develop and disseminate standard protocol for field collection of DNA samples, e.g., pathogens, skin bacteria, dead specimens	Medium	Short	Standard protocol document for collecting DNA on the ground in place by the end of year 2	ASG-Mad, Durrell	
1.8 Update the process, including permits and systems, for the collection and export of samples for analysis	High	Short	Permits and systems for export of samples reviewed and improved by end Year 1. Measure: review documents Export options and conditions agreed with export companies and Institute Pasteur Year 1 (minutes) Procedure guidelines for expediting permits for export in place by end Year 1 Database of researchers travelling to / from Madagascar created by Year 1	MEEMF, DGF, ASG-Mad, CEC, Institute Pasteur	Includes samples for pathogens, tissue, dead frogs. Important to ensure reports are filed with MEEMF for all permits issued. ASG-Mad consulting body for research applications.

1.9 Develop a strategy for the maintenance and development of molecular labs in Madagascar	Medium	Long	<p>Produce a report detailing exactly what needs to be done (e.g. funding, resources, skills) to allow 'in-house' molecular/DNA work by end Year 2</p> <p>Report identifying and assessing lab options in Madagascar by end Year 2</p> <p>Strategy to develop collaborations with overseas laboratories developed by end Year 2</p> <p>Suitable options under development by Year 5</p>	ASG-Mad, CVB, UADBA and other Universities, Government	Labs with appropriate facilities exist - ValBio, Institut Pasteur, UADBA. Issues of funding, i.e., providing consumables, materials, storage
1.10 Encourage researchers to lodge call and photographic info as well as specimens	Low	Long	<p>New collaboration between ASA-AmphibiaWeb explored by end Year 2</p> <p>Researchers consistently lodging call data, photos along with specimens in database collection by Year 5</p>	ASG-Mad, ASA	South African website model for photo catalogue. See i-naturalist. Need buy-in of researchers to upload photos.
1.11 Improve the state of existing herpetological collections in Madagascar - review, management, access	Medium	Long	<p>Curator / volunteer system in place to help management by end Year 3</p> <p>Collections managed efficiently as measured by regular reports by end Year 5</p> <p>Existing databases of Madagascar based collections beginning to go online by end Year 5</p> <p>Report on review of state of collections with recommendations for improvement and development completed by end Year 5</p>	ASG-Mad, institutes with collections	Priority for Smithsonian to develop taxonomic collections in developing countries. Include ensuring lab purchases

Theme 2: Monitoring Madagascar's amphibians and their environment

Action	Priority (H, M, L)	Timeframe (S, M, L)	Indicators (By end of time frame or 5 years)	Institutions	Notes and Comments
2.1 Identify key species and sites where it is currently feasible to undertake monitoring and a priority list of species and sites for future monitoring with new partners	High	Short	Document listing all feasible key species and sites for monitoring produced by end Year 1 Identify standard methods for the feasible key species and sites by end Year 1. Trialed by end Year 2 Conservation Needs Analysis done and list of priority species and sites for monitoring produced by end of Year 2 Priority species and sites lists reviewed in Year 5	ASG-Mad, CEC, various NGO's, Aark, Malagasy Institutes (Universities, PBZT)	Monitoring already being conducted at Betampona, Ankaratra, Andasibe and Mangabe. Monitoring of <i>M. cowani</i> starting. Ranomafana identified as another site. Should be linked to <i>Bd</i> monitoring where possible i.e. National Chytrid Monitoring Plan Sites. Requires coordination to share monitoring protocols.
2.2 National protocols for amphibian monitoring, including data for occupancy models, in place	High	Short	Protocols developed in Year 1 National amphibian monitoring protocols being used by end Year 2	ASG-Mad, University of Hamburg, Malagasy Universities	Methodology including site specific species and environmental/abiotic data. Data for occupancy modelling is a priority. Some may already have been done by MaVoa, Chester
2.3 Monitoring species and sites	High	Long	A standard monitoring form for sites to aid reporting developed by end Year 1 Annual reports for all feasible key species and sites produced 30% of all priority identified species with regular monitoring in place by end Year 5	ASG-Mad, CEC, various NGO's and institutions	
2.4 Recruit and train new local partners to conduct monitoring on amphibians in new priority sites	Medium	Long	Training programmes conducted at least 1 new priority site per year Training reports produced	ASG-Mad, Durrell, Chester, Kent	

2.5 Identify high elevation sites for future survey and sites that have been surveyed but for which data have not been published	Medium	Medium	Document identifying important high elevation sites by end Year 2 Existing surveys identified and data made available by end Year 3	ASG-Mad, various NGOs	Need to locate and collate information on previous work done
2.6 Further the use of static acoustic surveys for monitoring amphibians	Medium	Long	Use of acoustic recorders trialled in at least 2 sites by end Year 3 Acoustic recorders incorporated into long-term monitoring programmes by end Year 5 Acoustic database developed and new calls added to it by end Year 2	ASG-Mad, NGO's, Universities, PBZT	Potential as a PhD project. Need to identify Universities and Professors. Betampona, Ankarata and Ambohitantely potential study areas. A database of some calls already exists
2.7 Investigate and develop the use of environmental DNA for monitoring species	Low	Long	Discussions with experts underway by end Year 2 Techniques tested by end Year 4	ASG-Mad, NGO's, Universities	Another potential student project. Betampona, Ankarata and Ambohitantely potential study areas.
2.8 Meteorological monitoring undertaken at long-term monitoring sites	High	Short	Meteorological data collection protocol document in place by end Year 2 Existing meteorological stations identified by end Year 2 Partnership with the weather service explored by end Year 2 Feasibility of establishing weather station installation at each site conducting long-term monitoring assessed by end Year 2 Weather stations established where feasible or alternate options identified by mid-Year 3 Daily meteorological data collection undertaken and included in yearly monitoring reports and annual summary report	ASG-Mad, MFG, NGOs, Directorate of Climate Change, Local communes	Direction General de la Metereologie could be engaged. Feasibility of this in remote locations is questionable

Climate Change						
2.9 Locate and collate information on species adaptability to Climate Change	Medium	Short	Existing data located and collated in database ready for analysis by end Year 2	ASG-Mad	Data already available. Potential PhD project.	
2.10 Model species adaptability to Climate Change and the likely mitigation success	Medium	Medium	Modelling completed and report produced by end Year 4	ASG-Mad, Universities, National research centres	Good potential PhD project	
2.11 Update Key Biodiversity Areas (KBA) for amphibians to include Climate Change	Low	Long	Preliminary research report required to update KBAs completed by end Year 5	ASG-Mad, research institutes	No preliminary work done. Climate Envelope analysis	
2.12 Model invasive species spread including the influence of Climate Change	Medium	Long	Report identifying key invasive species by end Year 1 Invasive species likely spread modelled by Year 5	NWU, Universities, National research centres	Potential PhD project	

Theme 3: Emerging infectious diseases

Action	Priority (H, M, L)	Timeframe (S, M, L)	Indicators (By end of time frame or 5 years)	Institutions	Notes and Comments
Research					
3.1 Maintain National Monitoring Plan for chytrid at 8 core sites for duration of action plan	High	Long	Organisations to carry out monitoring confirmed by mid-Year 1 Monitoring carried out at all 8 sites twice a year (annual report)	CEC, Durrell, Mitsinjo, MFG, MaVoa and other NGOs at specific sites	Do NGO's have the will to continue - need to find out. Mitsinjo and MFG willing to undertake at Andasibe and Ivoloina. Another partner at Antoetra needs to be identified
3.2 Prepare and distribute a standardized pre-printed data sheet for chytrid sampling and monitoring	High	Short	Data sheet created and disseminated to all organizations carrying out monitoring plan by end Year 1	CEC, ASG-Mad, CIBIO, Durrell	Data sheet needs to be in Malagasy, French and English. Angelica to prepare packs for distribution in Madagascar.
3.3 Review the National Monitoring Plan methodology in light of new information and research	High	Medium	Review carried out in 2 years Review carried out in 5 years	CEC, ASG-Mad, CIBIO	Don't have the base line data yet to review on species susceptibility. Include potential for additional population monitoring at core sites.
3.4 Undertake chytrid surveys on an ad hoc basis at additional important sites as identified	High	Long	Identification of the sites and of the organisations that will commit for the swab collection by the end of Year 1 Reports on chytrid surveys carried out at least once a year at a further 2 sites	ASG-Mad, CEC, CIBIO, interested NGOs	CVB willing to undertake at Ranomafana. Potential sites include: Betampona, Ankarana, Makay, Tamatave, Fierenana, Nosy Be (Val Clarke), Mangabe?

3.5 Assess the feasibility of incorporating <i>Ranavirus</i> and other disease monitoring at core sites	Medium	Medium	Protocol for monitoring and assessing developed by start Year 2 Feasibility study and report completed by Year 2 If feasible protocol developed and incorporated from Year 4	ASG-Mad, CEC, Imperial, ZSL, NWU	Finding funds is the key factor in its feasibility
3.6 Identify the lineage(s) of amphibian chytrids present in Madagascar	High	Medium	Chytrid lineage(s) publically identified by end Year 2	Imperial, ZSL, CIBIO, ValBio, Universities, Durrell	Needs to be done before Action 3.7 as protocol varies according to environment. Requires access to autoclaves & ability to pour sterile agar plates (sterile HEPA hoods) / 4 °C cold chain/ incubators. Institute Pasteur and Ranomafana are likely only options in Mada
3.7 Develop the capacity among research community in Madagascar for isolating chytrid	Medium	Short	Partners who will make and distribute sterile chytrid isolation reagents by end of 1 Year after 3.6 completed Chytrid research community have and use isolation protocol and understand who will make/distribute the reagents by end of 1 Year after 3.6 completed Training workshop undertaken in Year 1 after 3.6 completed. Training report produced	CEC, ASA	Chytrid lineage needs isolating first. Chytrid isolation is complex and requires sterile conditions/ working environment, hypodermic needles and 4 °C coolers. Workshop to ensure understanding of protocol

<p>3.8 Disseminate chytrid and other disease hygiene / biosafety protocols to all researchers and other key groups e.g. tourists, exporters working in/visiting Madagascar</p>	<p>High</p>	<p>Short</p>	<p>All research and exploration permits issued include hygiene protocols by end of Year 1 All groups and mechanisms for dissemination to them identified in Year 1 Protocol and associated information materials disseminated by end Year 2</p>	<p>CEC, MEEMF, DGF, ASG-Mad, ASA, Chester, EAZA</p>	<p>All researchers in Madagascar. Other potential targets include: Travel agencies / associations, hotels, airport, National Parks, tourist guide books; aquatic food importers/exporters; amphibian exporters</p>
<p>3.9 Enhancement of mitigation research in Madagascar</p>	<p>High</p>	<p>Long</p>	<p>Distribution of the results of the probiotic research by the end of year 2 Characterisation of microbial communities in <i>Bd</i> positive and <i>Bd</i> negative sites with culture and culture-independent methods and metagenomics (preliminary data available at the end of the 1 Year) Annual progress reports including bibliographies of publications Establish protocol for the characterization of aquatic microorganism communities in relation to <i>Bd</i> presence-absence in Madagascar by the end of year 1 Implementation sites identified (mid 1 Year) Protocol distributed to organisations (end 1 Year) Annual progress reports including bibliographies of publications</p>	<p>CEC, JMU, CIBIO, TU-Germany, Dirk Schmeller</p>	<p>All rules regarding use of Probiotics to be created in partnership with CEC</p>

3.10 Undertake susceptibility trials on species using the identified chytrid lineage and the virulent strain most likely to invade	Medium	Medium	Species for susceptibility trials identified by end of Year 1 Susceptibility trial reports by end of Year 4	ZSL, Imperial, NWU, Malagasy Universities	Timing will depend on when the chytrid lineage is identified. Trials with a virulent lineage can begin as soon as funding is received. Should be done where possible in collaboration with Malagasy institutes to build capacity.
3.11 Protocol for storage of biological samples disseminated	High	Short	Protocol document disseminated to all necessary groups Year 1	ASG-Mad, ZSL, CIBIO	
3.12 Assess the presence / extent of chytrid within the internally traded frog species	Medium / High	Medium	Disease monitoring programme for internally traded species in place and underway by end Year 2	CEC, ASG-Mad, national traders / organisations	<i>Hoplobatrachus tigrinus</i> / <i>Boophis goudoti</i> in market places
Coordination and Communication					
3.13 Identify a person to assist CEC with coordination and communication of chytrid work in Madagascar and define internal communication structure between CEC members and partners	High	Short	Person in place with Terms and Conditions by end Year 1 Terms of Reference for CEC Coordinator defined Memorandum of Understanding for CEC members and partners in Year 1	CEC, ASG-Mad, MEEF	Mdm Sahondra said that there will be someone in the Cellule to assist in this.
3.14 Develop and put in place an emergency response strategy for a mass die off event or demonstration of a novel rapid population decline	High	Short	Emergency response strategy in place within the CEC/Government by end Year 1	CEC, ASG-Mad, ASA, Durrell, ATAG/EAZA, Chester, national institutions	Not to be communicated publicly. In place in case it has to be implemented in the future.

3.15 Develop and disseminate set of guidelines for how people can report and respond to dead frogs	High	Medium	Guidelines produced Year 1 Strategy document for dissemination of guidelines produced Year 1 Dissemination underway by end Year 1 and all audiences reached by end Year 3 Local communities at priority monitoring sites aware of how to respond to dead frogs by end Year 1 (education session reports)	CEC, ASG-Mad, Durrell, ASA, Chester, ATAG/EAZA, ZSL, CIBIO	WWF guidelines for tortoise trade could be adapted for this purpose. Strategy for its dissemination includes audiences and methods for awareness raising e.g. posters, training
3.16 Annual chytrid updates given to all Protected Area managers	High	Long	Updates given at MNP annual meetings (meeting minutes) Annual updates given to other Protected Area managers e.g. DCSBAP (meeting minutes)	CEC, ASG-Mad, MNP, MEEMF	In addition to regular CEC meetings. To review with Government and MNP.
3.17 Boot wash and dip/spray stations at strategic places (e.g. entrance, start of hiking trails) in every National Park	High	Medium	Boot dips/spray stations in place at every National Park accompanied by instructions on use by end of Year 2	CEC, MNP, ASA	Look at Clorox as a potential sponsor (Reid Harris has contacts). Primarily for education / awareness perspective (Linked to Action 3.8). Useful for many wildlife pathogens not just <i>Bd</i>
3.18 Engage with amphibian exporters to become part of the disease efforts in Madagascar	Medium	Medium	Amphibian exporters members of the CEC by Year 2 Signed agreements in place by Year 4	CEC, ASG-Mad, MEEMF	Action to formally increase the engagement of amphibian exporters in disease monitoring efforts

3.19 Identify diagnostic services for animal health services to identify chytrid and other pathogens at the local level	Medium	Medium	Revised diagnostic guidance in place by Year 4	National Vet department, Institute Pasteur	None of the international participants understand what this relates to. This is a National need so should keep.
3.20 Disseminate guidelines for reducing risk of disease transmission through the translocation of amphibians	High	Short	Relevant groups identified Year 1 Guidelines disseminated Year 2	CEC, ASG-Mad, MEEFMF	Guidelines already developed. Where are they?
3.21 Integrate risk factors from aquatic products (aquatic plants and animals, water) transfer into animal trade regulations	High	Medium	Animal trade regulations updated to include risk factors by end Year 3	CEC, ASG-Mad, MEEFMF	Risk factors already developed
3.22 Incorporate national monitoring data into online chytrid maps	High	Long	Existing data incorporated into online maps Year 2 Annual updates done	ASG-Mad, CEC, ZSL, Imperial (Cartes Bd), CIBIO	AmphibiaWeb-ASA collaboration can be helpful.

Theme 4: Site management for the conservation of amphibians

Action	Priority (H, M, L)	Timeframe (S, M, L)	Indicators (By end of time frame or 5 years)	Institutions	Notes and Comments
4.1 Analyze existing Protected Areas in relation to the red list of amphibians	High	Short	Analysis completed by May 2016	Rebioma, MaVoa, CI	
4.2 Identify priority sites for amphibians not in current Protected Area	High	Short	Gap analysis report identifying priority sites done by end Year 2	Rebioma, MaVoa, CI	A workshop will likely be required to share findings before report
4.3 Promote the integration of the management of priority sites for amphibians within various management plans (Plan GRAP, SMIP, Regional Plan)	High	Long	Priority areas for amphibian conservation within all management plans by end Year 2 (report) Amphibians included in 25% of management plans by end Year 5	MNP, Durrell, concerned land managers	Both within and outside PAs. Other conservation groups working in areas for other species. Will likely require a series of workshops.
4.4 Identify and develop conservation strategies for species affected by development projects at national level	Medium	Long	Review of all national development projects and priorities done every 6 months and report produced Conservation strategies for species affected developed for operators Network to ensure information used for conservation developed end Year 1	ASG-Mad	e.g. Mining developments, oil routes.
4.5 Establish fire management strategies in key sites for amphibian conservation	High	Long	Report assessing key amphibian sites for fire management strategies by end Year 2 Fire management strategies implemented at identified sites by end Year 5 (site management reports)	Managers of key sites (MNP, Ministry, DCSBAP)	
4.6 Explore land acquisition options for important amphibian sites (purchase, rental)	Low	Long	Report identifying potential sites for land lease / purchase by end Year 3 Report determining the feasibility and legality of site options by end Year 5	ASG-Mad, Ministries	This is only an option not a certainty. Need to explore feasibility and legality.

4.7 Promote protection of existing corridors and recommend additional corridors to increase connectivity for sites with important amphibian assemblages	Medium	Long	<p>Research report into effectiveness of corridors for amphibians done by end Year 3</p> <p>Site managers engaged regarding corridor protection / creation (meeting minutes)</p>	ASG-Mad, MEEFMF, PA managers	Issue - spread of disease; insufficient information showing the importance of corridors. Start by protecting existing corridors. Preventive measure against emerging diseases
4.8 Identify options for amphibians to support human livelihoods at focal sites	Low	Long	Reports on amphibian related livelihood options produced for all key / focal sites by end Year 5	ASG-Mad, MaVoa, NGOs	e.g. Ecotourism potential

Theme 5: Harvesting and trade of amphibians

Action	Priority (H, M, L)	Timeframe (S, M, L)	Indicators (By end of time frame or 5 years)	Institutions	Notes and Comments
5.1 Annual surveys of species collected for consumption and pet trade	Medium	Long	Baseline data on species generated by end of Year 2 Annual surveys done and report produced including recommendations on quotas by site and subpopulations made	ASG-Mad, Chester, MaVoa, SCAM	Surveys to include information on quotas, specific collection locations etc
5.2 Conduct trade review of non-CITES species	Medium	Medium	Report identifying internal non-CITES trade species by end Year 2 Identified species incorporated into annual surveys (Action 5.1) in Year 3	ASG-Mad, Chester	Potential student project. <i>Boophis goudoti</i> and <i>Mantidactylus grandieri/guttulatus</i> potential species
5.3 Undertake a Population and Habitat Viability Assessment (PHVA) of species collected for food and pet trade	Medium	Long	Identification of the list of species by end of year 2 Data collection for PHVA begun by Year 3 PHVA workshop by Year 4 PHVA reports for each threatened trade species by end Year 5	ASG-Mad, MEEFM, research centres and associations, University student project	
5.4 Develop the engagement between conservation community and the traders and exporters to improve monitoring	High	Medium	Key meetings with traders and exporters by end Year 1 Database of information obtained from traders developed by end Year 2 Revision of collection sites by the end Year 2	MEEFM, ASG-Mad, traders and exporters	Action 3.24 relates specifically to engaging over <i>Bd</i>
5.5 Develop standardised methodology for identifying species at risk through the pet trade	Medium	Medium	Methodology documents produced and being used (survey reports) by end Year 5	ASG-Mad	Challenging as different species require different methods. Existing methodology available through CITES website

Theme 6: Captive breeding and zoo actions

Action	Priority (H, M, L)	Timeframe (S, M, L)	Indicators (By end of time frame or 5 years)	Institutions	Notes and Comments
6.1 AArk conservation needs assessment done for all Malagasy amphibian species and used as basis to develop an <i>ex situ</i> action plan for Madagascar	High	Short	Conservation needs assessment reports done by end Year 1 <i>Ex situ</i> action plan for Madagascar developed and in place by mid-Year 2 Conservation needs assessments are reviewed and updated in light of new information from susceptibility trials and disease distribution (review reports)	AArk, <i>Ex situ</i> Coordinator, ASG-Mad, Durrell, EAZA / ATAG, Chester, national amphibian experts	High level action will inform future direction
6.2 Appoint a Madagascar <i>Ex situ</i> Conservation Coordinator	High	Short	Coordinator in place by end of Year 1 Terms of Reference produced	ASG-Mad, AArk	AArk have secured funds from zoos for similar positions in other countries. Options for establishing a committee as well
6.3 Centralise all protocols, management documents related to the captive breeding of Malagasy species	Low	Long	Online repository identified by Year 2 All documents deposited in a centralised database annually from Year 3	<i>Ex situ</i> Coordinator, ATAG/EAZA, AArk	AArk web site already has an extensive Husbandry Documents library that should be used as a central resource: www.amphibianark.org/husbandry-documents/
6.4 Ensure all protocols and documents are available in English, French and/or Malagasy	Low	Long	All initial documents in database translated by end Year 4 All documents deposited in at least two languages	<i>Ex situ</i> Coordinator, ATAG/EAZA, Paris Zoo, Thoiry Zoo	
6.5 Incorporate management data for in country <i>ex situ</i> facilities into the ZIMS/ISIS network	Medium	Long	Implementation options reviewed and best way identified in Year 2 Data incorporated into ZIMS by Year 3 and regularly updated	<i>Ex situ</i> Coordinator, Durrell, Chester, ATAG/EAZA	Options include: via regional membership; zoo sponsorship; funds for Coordinator to fund membership

6.6 Madagascar based <i>ex situ</i> staff trained in ZIMS	Medium	Short	ZIMS training courses run during Year 2 (reports)	<i>Ex situ</i> Coordinator, Durrell, Chester, ATAG/EAZA	Regular resources to run the training courses
6.7 Establish a training network to improve captive breeding capacity in Madagascar and ensure long-term stability of current and future captive breeding colonies	High	Long	Members identified and contacted by end Year 2 Network in place and operational by Year 3 (network meeting minutes) Annual training of captive breeding staff undertaken (training reports) Follow-up assessments of trained staff done every 2 years	<i>Ex situ</i> Coordinator, Durrell, AArk, Chester, ATAG/EAZA, ASG-Mad, ASA	
6.8 Rapid-response protocol developed in the case of having to take species out of the wild into captivity	High	Short	Protocol document including both in and out of country options in place by the end of Year 1 Approved protocol document by authorities Q1 Year 2	<i>Ex situ</i> Coordinator, Durrell, AArk, Chester, ATAG/EAZA	Linked to Action 3.17 Includes in and out of country options
6.9 Conduct public awareness to educate public in Madagascar on <i>ex situ</i> programmes	Low	Long	Awareness activities and target audiences identified by end Year 1 Activities conducted and documented (reports, photos)	<i>Ex situ</i> Coordinator, Durrell, AArk, Chester, ATAG/EAZA, ASG-Mad, captive breeding centres	Most important around areas where <i>ex situ</i> programmes exist. Linked to Action 1.6. Role of everyone
6.10 Madagascar captive breeding community engage with overseas zoo community to strengthen networks for research using <i>ex situ</i> colonies	Medium	Long	Overseas institutions interested to support the <i>ex situ</i> component of ACSAM 2 and their potential identified by Q1 Year 2 Research questions, plan and budget for <i>ex situ</i> communities in and out of country developed by end of Year 2 Zoo research network established with regular documented exchanges by end of Year 2	<i>Ex situ</i> Coordinator, AArk, ASG-Mad, ASA, Durrell, Chester, ATAG/EAZA	Strong link between coordinator in country of <i>ex situ</i> and representatives from outside Madagascar

6.11 Conduct associated <i>in situ</i> work in support of <i>ex situ</i> work as directed by AArk conservation needs assessment	High	Long	<p><i>In situ</i> research priorities identified through the AArk conservation needs assessment Q2 Year 1</p> <p>Reports of <i>in situ</i> research produced and presented</p>	ASG-Mad, AArk, MFG, NGOs's	Lack of groups / researchers to undertake <i>in situ</i> research
6.12 Identify priority species and sites for assisted colonisation	Medium	Long	<p>Species where assisted colonisation is a priority need to be identified and report produced by end Year 3</p> <p>Sites identified and report produced by end Year 5</p> <p>Strategy and procedures for assisted colonisation produced by end of year 5</p>	ASG-Mad, AArk	





Boophis rufioculis © Gonçalo M. Rosa

OVERVIEW

Before developing a new, updated Sahonagasy Action Plan the participants reviewed the progress made against the actions of the first Sahonagasy Action Plan (SAP), developed as a result of the first ACSAM meeting in 2006. This was done in two groups during the afternoon session on Wednesday 19 November 2014 for Themes 1, 2, 4, 5, 6 and 8. Reviews of the Theme 3 (Disease) and Theme 7 (Captive breeding) were done at the beginning of those particular sessions on Thursday and Friday.

This was a fairly quick appraisal of the progress against the original actions as a comprehensive review had been carried out in 2012 and the results published in the peer-review journal *Alytes*. This paper formed the basis of conducting the review at ACSAM2:

Andreone, F., Carpenter, A.I., Copsey, J., Crottini, A., Jenkins, R.K.B., Köhler, J., Rabibisoa, N.H.C., Randriamahazo, H. and Raxworthy, C.J. (2012) Saving the diverse Malagasy amphibian fauna: where are we four years after implementation of the Sahonagasy Action Plan. *Alytes* **29**:44–58.

One of the main comments made by many of the participants was that it was very difficult to say for certain whether an action had been achieved as many were not SMART. That is they were very broad in scope, with no measurable indicators and not time-bound. As such many actions were listed as being partially completed with no measure of the amount achieved. This was an area that the participants felt needed to be addressed when developing the new action plan.

REVIEW OF 2008 ACTIONS

Below is the review of the priorities as conducted by the participants at ACSAM2. The format is based on the Alytes paper. Whether each action was accomplished was assessed as either **YES** (totally accomplished), **PARTIAL** (partially accomplished) or **NO** (not completed or no information available regarding completion). The main comments made by the participants in relation to each action are also provided.

Theme 1: Coordination of research and conservation activities

2008 Sahonagasy Action Plan priorities	Actions	Accomplished and comments
Establish Amphibian Executive Secretariat	Establish a full time salaried Amphibian Executive Secretariat	PARTIAL : Achieved for the first 5 years. No funding since 2013
Define standards for the collection and use of DNA samples	Define labs in Madagascar that could do DNA work	YES
	Establish data sharing protocol for DNA data	NO
	DNA extraction, PCR and data analysis facilities operational in Madagascar	NO : None being done as of 2014. There are difficulties doing this in country
	Obtain regular and stable funding for DNA analysis consumables	NO
Raising awareness	Produce guidebooks	YES but distribution must be facilitated
	Produce information booklets and other communication tools	YES Awareness must be ongoing
Management of an amphibian information website	Establish a species website and initiatives	YES but needs further development and ongoing maintenance



Boophis pyrrhus © Gonçalo M. Rosa



Chytrid monitoring at Ankaratra. © Jeff Dawson

Theme 2: Monitoring Madagascar's amphibians

2008 Sahonagasy Action Plan priorities	Actions	Accomplished and comments
Establish a monitoring protocol for threatened and traded species	Regular surveys of commercially exploited species	PARTIAL not for all species
	Regular surveys of threatened species	PARTIAL not for all species
	Training of parabiologists to collect data on amphibians	PARTIAL but is an ongoing action
	Training of local guides to collect data on amphibians	PARTIAL but is an ongoing action
	Involve local specialists in monitoring projects	PARTIAL but is an ongoing action
	Evaluate the successes of ongoing conservation actions	PARTIAL definitely done for golden mantella project
	Encourage on-line deposition of data and photographs	YES
Monitoring selected communities	Analyse important community parameters	PARTIAL ongoing action
Long-term assessment of two sites	Establish two TEAM sites in Madagascar (East and West)	PARTIAL only East site identified (not TEAM)
	Establish other sites that use similar methods	PARTIAL Mangabe, Sahamalaza? (not TEAM sites)
	Establish a specific acoustic library	YES but may need updating
	Establish cautionary hygiene protocols	YES but doubts over whether it is used widely
Monitoring at elevational transects	Regular altitudinal surveys	PARTIAL

Theme 3: Managing emerging amphibian disease

2008 Sahonagasy Action Plan priorities	Actions	Accomplished and comments
Determine the <i>Bd</i> status of Madagascar amphibians	<p>Screening of frogs across taxonomic ranges</p> <p>Screening of frogs in areas with high diversity and unique assemblages</p> <p>Screening of frogs in port of Toamasina</p> <p>Quantitative analysis through susceptibility experiments to identify sensitive species in which the disease can develop</p> <p>Quantitative analysis by considering risk factors that are most frequently associated with <i>Bd</i>-induced population declines</p> <p>Annual monitoring for <i>Bd</i></p>	<p>PARTIAL should update to include ranavirus</p> <p>YES</p> <p>PARTIAL only through screening of some toads</p> <p>PARTIAL</p> <p>PARTIAL</p> <p>YES</p>
Revise animal and equipment trade regulations (importation)	<p>Revise diagnostic services of animal health services to identify <i>Bd</i> / other pathogens</p> <p>Develop guidelines for amphibian translocations that include specific quarantine and testing recommendations</p> <p>Incorporate the risk factors of pathogen transfer from aquatic products into the animal trade regulations</p>	<p>PARTIAL some uncertainty over what it means</p> <p>YES</p> <p>PARTIAL risk factors developed but not incorporated</p>
Develop a hygiene protocol	<p>Design a protocol that includes the handling of frogs in the field, husbandry and laboratory practices and customs regulations</p> <p>Ensure the protocol is relevant to the scientific and animal trade communities</p>	<p>PARTIAL field and lab protocols done</p> <p>NO</p>
Stakeholder communication on Pathogen Action Plan objectives	<p>Appoint an emergency response team for the purpose of investigating any reports of amphibian mortality</p> <p>Develop a national database of amphibian pathogen related events</p> <p>Use communication opportunities for sharing information about the results of <i>Bd</i> surveys in Madagascar</p>	<p>YES</p> <p>NO</p> <p>PARTIAL</p>

Theme 4: Climate change and amphibians

2008 Sahonagasy Action Plan priorities	Actions	Accomplished and comments
Modelling of target species	<p>Use models to assess adaptability of species and likely mitigation successes</p> <p>Predicting shifts of the distribution of amphibians from predicted changes of climate and vegetation</p> <p>Identify important amphibian refuges for adaptation to climate change</p>	<p>PARTIAL information is available but no modelling done</p> <p>PARTIAL done for 1 site but needs updating</p> <p>NO how useful / feasible is this?</p>
Monitoring programme to detect threats to amphibians due to climate change	Annual monitoring established at elevational transects	NO how feasible is this? Sites still need identifying and other preliminary work done before this can happen
Expanding protected areas by creation of refuge areas	<p>Expand protected area system for amphibians</p> <p>Update existing protected area management plans by including climate change</p> <p>Adjust existing protected area boundaries to accommodate for range shifts</p> <p>Update fire management strategies</p> <p>Translocate highly threatened montane amphibians or move them to captivity</p> <p>Manage protected areas and incorporate connectivity</p>	<p>PARTIAL some sites have been expanded. Ongoing activity</p> <p>NO this is a long-term goal. No preliminary work done. Is it a high priority in light of other threats?</p> <p>NO boundaries being changed by external processes e.g. deforestation</p> <p>NO but is important for amphibians</p> <p>NO species have not been identified</p> <p>NO</p>

Theme 5: Management of focal amphibian sites for conservation

2008 Sahonagasy Action Plan priorities	Actions	Accomplished and comments
Data collection in the field	<p>Regular monitoring of amphibians and key habitats</p> <p>Survey potential areas for priority species</p>	<p>PARTIAL more needs to be done</p> <p>PARTIAL at some sites, more needs to be done</p>
Supporting local populations	Establish the value of focal amphibian sites for human livelihoods	PARTIAL
Integrating focal amphibian sites in the protected area network	<p>Establish a task force to identify potential areas for protected species</p> <p>Promote amphibian conservation in existing protected areas</p> <p>Establish new protected areas for amphibians</p> <p>Scrutinize the literature for developments that significantly impact species conservation priorities</p>	<p>NO</p> <p>PARTIAL not all protected areas have these</p> <p>YES but want more</p> <p>PARTIAL but is an ongoing action; need to clarify the intent of action</p>

Theme 6: Harvesting and trade of amphibians

2008 Sahonagasy Action Plan priorities	Actions	Accomplished and comments
Develop extraction models for setting harvest quota	Assess the impact of collection on edible frogs	YES
	Study the ecology of frog species collected for local consumption	YES
	Socio-economic study on edible frog trade	YES
	Conduct Population Viability Analysis (PVA) of threatened species in the trade	NO
Establish improved economic and management structures and procedures	Monitor international trade	YES but ongoing
	Assess the trade chain	YES
	Periodic review of national legislation concerning amphibians	PARTIAL
Integrate trade / collection models into economic management	Assess potential for farming endemic edible frogs in Madagascar	NO not feasible
Capacity building / knowledge transfer	Direct contact made between Madagascar and other CITES authorities	YES



Boophis viridis © Gonçalo M. Rosa

Theme 7: Captive breeding and zoo action

2008 Sahonagasy Action Plan priorities	Actions	Accomplished and comments
Collection of data in the wild	Field studies on candidate captive breeding species	PARTIAL
	Develop standardised protocols for the management of priority species	PARTIAL protocols at Mitsinjo but vary between species
	Monitor environmental parameters at sites with candidate captive species	NO
	Research on breeding behaviour	NO
Selection of breeding and priority species	Prioritise threatened species for captive breeding using established methods	YES but AARK assessment needs updating
	Prioritise "ecological guild" species for captive breeding using established methods	YES but AARK assessment needs updating
	Identify institutions or individuals to breed each species by Amphibian ARK	PARTIAL
Education programmes	Public awareness activities focussed on <i>ex situ</i> colonies	NO
Training	Training and capacity building on captive breeding in Madagascar	YES but ongoing
Reinforce wild populations	Field assessment of sites to receive reinforced populations	NO

Theme 8: Development of a unified herpetological collection

2008 Sahonagasy Action Plan priorities	Actions	Accomplished and comments
Purchase of laboratory materials	Provide needed instruments	NO
Cataloguing of existing specimens	Establish a joint management system of the two existing collections	PARTIAL
	Establish a single database for the two existing collections	NO
Sharing the specimens and curator	Salaried curator recruited	NO
Permanent education facilities	Increased awareness	PARTIAL



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